UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/893,340	06/26/2001	Sien G. Kang	018419-008320US	2640

20350 7590 09/24/2002

TOWNSEND AND TOWNSEND AND CREW, LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

EXAMINER
KIELIN, ERIK J

ART UNIT	PAPER NUMBER
2813	9

DATE MAILED: 09/24/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/893,340	Applicant(s) KANG ET AL.
	Examiner Erik Kielin	Art Unit 2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 July 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *29-39* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *29-39* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☒ The proposed drawing correction filed on *22 July 2002* is: a)☒ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Drawings

1. The proposed drawing correction and/or the proposed substitute sheets of drawings, filed on 22 July 2002 have been approved. A proper drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The correction to the drawings will not be held in abeyance.

INFORMATION ON HOW TO EFFECT DRAWING CHANGES

1. Correction of Informalities -- 37 CFR 1.85

New corrected drawings must be filed with the changes incorporated therein. Identifying indicia, if provided, should include the title of the invention, inventor's name, and application number, or docket number (if any) if an application number has not been assigned to the application. If this information is provided, it must be placed on the front of each sheet and centered within the top margin. If corrected drawings are required in a Notice of Allowability (PTOL-37), the new drawings **MUST** be filed within the **THREE MONTH** shortened statutory period set for reply in the "Notice of Allowability." Extensions of time may NOT be obtained under the provisions of 37 CFR 1.136 for filing the corrected drawings after the mailing of a Notice of Allowability. The drawings should be filed as a separate paper with a transmittal letter addressed to the Official Draftsperson.

2. Corrections other than Informalities Noted by Draftsperson on form PTO-948.

All changes to the drawings, other than informalities noted by the Draftsperson, **MUST** be made in the same manner as above except that, normally, a highlighted (preferably red ink) sketch of the changes to be incorporated into the new drawings **MUST** be approved by the examiner before the application will be allowed. No changes will be permitted to be made, other than correction of informalities, unless the examiner has approved the proposed changes.

Timing of Corrections

Applicant is required to submit acceptable corrected drawings within the time period set in the Office action. See 37 CFR 1.185(a). Failure to take corrective action within the set (or extended) period will result in **ABANDONMENT** of the application.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 37 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

4. Claim 37 states the limitation "wherein said environment is said surface." There does not appear to be support for this limitation in the original disclosure.

5. Claim 37 is rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for an environment having the halogen and hydrogen gas, does not reasonably provide enablement for "wherein said environment is said surface." The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

The term "environment" is defined as "the circumstances, objects, or conditions by which one is *surrounded*" or, in broader terms as that which surrounds a person, place, or, in the instant case, a thing. (See Merriam Webster's Collegiate Dictionary, 10th ed., p. 388.) The surface cannot simultaneously be that which surrounds it. Accordingly, one of ordinary skill could not practice the method commensurate in scope with the claim.

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claim 36 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 36 is considered indefinite because claim 1 indicates that the substrate is an "SOI substrate" which is an acronym for silicon on insulator, in the instant specification. It is unclear how the substrate can now be simply silicon, as required by claim 36.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims **29** and 31-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over 6,251,754 B1 (**Ohshima** et al.) in view of US 5,141,878 (**Benton** et al.) and **Moriceau** et al. "Hydrogen annealing treatment used to obtain high quality SOI surfaces" IEEE International SOI Conference, October 1998, pp. 37-38.

Ohshima discloses a method a manufacturing an SOI substrate on which semiconductor devices are to be formed, comprising,

forming a cleaved monocrystalline silicon surface (called "detached surface" at col. 11, lines 36-56) which inherently has some surface roughness;

high temperature annealing the cleaved surface to remove surface roughness (called "flattening the surface") created by the cleaving process (Fig. 3, step P15; Fig. 4D-4E; col. 11, lines 50-56).

Ohshima does not teach the conditions of the anneal.

Benton teaches the benefits of doing a pre-bake anneal of a rough silicon surface in an HCl-H_2 mixture at a temperature of greater than 1000 °C, to "reduce native oxide films and to further smooth" the silicon wafer, wherein an exemplary anneal mixture is 0.9 liters/min HCl and 40 liters/min H_2 or a ratio of HCl:H_2 of 0.0225, which falls between 0.001 and 30, as further limited by instant claim 32. (See col. 2, lines 45-53.)

It would be obvious for one of ordinary skill in the art, at the time of the invention, to use the roughness-reducing, HCl-H_2 etchant anneal of **Benton** as the high temperature anneal of **Ohshima**, because **Ohshima** desires a native-oxide-removing, surface-flattening anneal to prepare the cleaved silicon surface for growth of an epitaxial layer, and because **Benton** provides the successful anneal conditions to provide such desired results.

Then the only difference is that the degree of surface roughness reduction is not indicated in **Ohshima**.

Moriceau discloses exposing a rough silicon surface to an etchant --which is specifically hydrogen (as further limited in instant claim 21)-- while annealing at a temperature of greater than 1000 °C to reduce the silicon surface roughness from about 50 Å to a less than 1 Å. This equates to a reduction in surface roughness of $[(50\ Å - 1\ Å)/50\ Å] \cdot 100 = 98\%$, which is greater than 90%, as further limited by instant claim 31. (See whole document -- especially third paragraph and Fig. 1.)

Note also that **Moriceau** also teaches that any native oxide is also removed by this etchant anneal, at the second sentence of the fourth paragraph, which is also a desired result of the **Ohshima** high temperature anneal (col. 11, line 55).

It would be obvious for one of ordinary skill in the art, at the time of the invention, to reduce the surface roughness of **Ohshima** by an amount of at least about 90%, as taught by **Moriceau**, because **Moriceau** teaches such surface reduction enables an especially planar surface for the fabrication of semiconductor devices, which is also the object of **Ohshima**.

Regarding claim 33, as noted above in **Benton**, it is the combination of HCl and H_2 interacting with the rough silicon surface that reduces the surface roughness.

Regarding claims 34 and 38, the epitaxial chamber of **Ohshima** is a thermal processing chamber because the anneal is carried out in this environment of the chamber.

Regarding claim 35, the cleaved surface is provided by controlled cleavage in Ohshima. (See at least Figs 2A-2F.)

Regarding claim 36, the 35 USC 112(2) rejection notwithstanding, the SOI substrate of Ohshima is a "silicon substrate" to every extent that it can be, since Ohshima, like Applicant, disclose SOI (silicon on insulator) substrates.

Regarding claim 37, the 35 USC 112(1) rejection notwithstanding, the environment in Ohshima is "said surface" to every extent disclosed by Applicant.

10. Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Ohshima** in view of **Benton** and **Moriceau** as applied to claim 29 above, and further in view of the article **Tate** et

al., "Defect Reduction of Bonded SOI Wafers by Post Anneal Process" Proceedings of the 1998 IEEE International SOI Conference, Oct. 1998, pp. 141-142.

The prior art of **Ohshima** in view of **Benton** and **Moriceau**, as explained above, discloses each of the claimed features except for indicating the heating ramp rate of 10 °C/second or greater.

Tate teaches a method of reducing surface roughness of cleaved SOI wafers using hydrogen etchant in a rapid thermal annealing using rates far greater than 10 °C/second. (See item entitled "3. H_2 anneal with rapid thermal annealer on Smart Cut SOI.")

It would have been obvious for one of ordinary skill in the art, at the time of the invention to modify **Ohshima** in view of **Benton** and **Moriceau,** to use high ramp rates in order to reduce the time required to smooth the surface and to reduce the thermal budget, because **Moriceau** teaches that high ramp rates should be used, and also because **Tate** specifically teaches that rapid thermal annealing works to reduce surface roughness of cleaved SOI substrates in a hydrogen-containing etchant.

11. Claim 39 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Ohshima** in view of **Benton** and **Moriceau** as applied to claim 29 above, and further in view of US 6,335,269 B1 **(Sato)**.

The prior art of **Ohshima** in view of **Benton** and **Moriceau**, as explained above, discloses each of the claimed features except for indicating the pressure of the anneal for reducing the surface roughness of the SOI substrate.

Sato teaches using a hydrogen etchant to reduce the surface roughness of a silicon surface wherein the pressure is, inter alia, atmospheric pressure, i.e. 1 atmosphere. (See col. 21, lines 12-28.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use 1 atmosphere of pressure during the anneal because **Ohshima**, **Benton,** and **Moriceau**, do not indicate or require any specific pressure and because **Sato** teaches at 1 atmosphere as well as elevated or reduced pressure will also work.

Moreover, Applicant has provided no evidence to indicate that the pressure during the anneal is critical to the reduction of surface roughness. Rather the instant specification teaches away from any such criticality, stating at p. 15, lines 8-9, "Chamber pressure was generally maintained at about 1 atmosphere, **but can be at others too**." (Emphasis added.)

Conclusion

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached at (703) 306-2794 or by e-mail at olik.chaudhuri@uspto.gov. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

EK

September 21, 2002

OLIK CHAUDHURI
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800